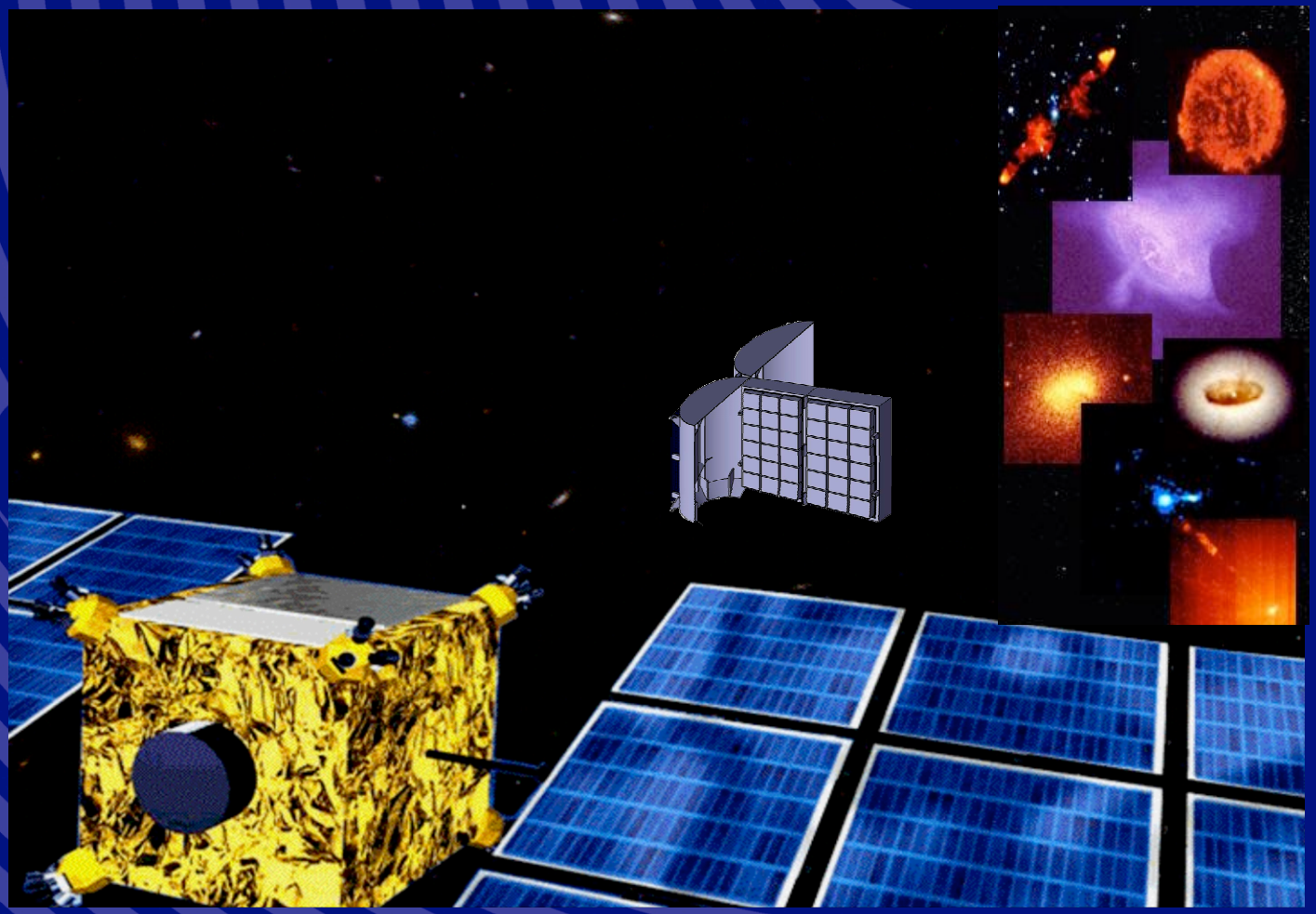
XEUS: X-ray Evolving Universe Spectroscopy



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XEUS – Activities in the next 2 years

- Two parallel sets of XEUS activities underway in ESA:
  - Mission approval via the Cosmic Vision process
  - Further industrial studies to better define mission critical elements (formation flying, mirrors, and their accommodation etc)
- Both sets of activities come together at the end of 2006 when XEUS will be ready to enter its definition phase (A/B1) as a fully approved mission.

XEUS – Cosmic Vision

- ESA is in the process of defining the science programme for 2015-2025 – Cosmic Vision 1525.
- The "science themes" of a major X-ray observatory was put forward into CV1525. Three main topics identified:
  - The birth and growth of the first massive black holes
  - The evolution of large scale structure in the Universe and the roles of Dark Matter and Energy
  - Probing GR and the nature of matter under extreme conditions
- Themes were presented at Paris workshop in 2004 September and then further reviewed by the ESA Science Advisory Structure (AWG etc and SSAC).

XEUS – Cosmic Vision

The (draft) SSAC CV1525 report identifies a future X-ray observatory as one of the highest priorities of the future ESA Science Programme:

- *"Noting that observational cosmology necessitates a multi-wavelength approach, no single observatory holds the key for completing the cosmic picture. However, a first priority will be to develop a new generation X-ray observatory that will be able to observe clusters of galaxies back to their formation epoch, making possible the study of the early heating and chemical enrichment of the intracluster gas, and their relation to AGN activity…"*
- *"The next major step requires a large X-ray observatory, with high sensitivity (~10m^2 collecting area) over a broad bandpass, ideally 0.1-50 keV, in order to handle the large photon rates of a high variety of events, high spatial resolution (~1-2_) to avoid source confusion, and microsecond time resolution to probe the relevant timescales."*
- *"The investigation of matter near black holes therefore has fundamental implications for physicists' understanding of black holes as well as for astrophysics and cosmology. Both the spectrum and the time-variability of radiation emitted by matter near black holes can carry the imprint of the curvature of space-time predicted by Einstein's general relativity. A large-area X-ray mission could probe gas very close to black holes."*

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XEUS – Cosmic Vision

- Darwin (planet finding) and XEUS science goals are emerging as the highest priorities of CV1525.
- Goal is to have XEUS as the next mission following the last approved ESA mission – Solar Orbiter which launches in 2013.
- ESLAB symposium in 2005 April at ESTEC is devoted to CV1525 – presentations and discussions on leading themes.
- After this there will be a “call for missions”. Unclear how much pre-selection there will be (a là NGST in the F2/F3 call) – need a clear view of the scope of international collaboration at this time.
- Mission call will occur after the next council of Ministers meeting which is probably early 2006, or late 2005. This meeting defines the level of resources for the ESA Science programme for the next 3+2 years.
- Final selection of CV1525 missions expected by the end of 2006.

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XEUS – Study Activities

Building on the strength of the XEUS science case in CV1525, 3 industrial spacecraft studies will be started in May 2005:

- DSC payload accommodation and design including the FF sensors.
- Mirror optical bench accommodation study. Includes thermal aspects, structure design, deployment, material choice etc.
- Formation Flying (FF) requirements and metrology. The output of this study will be an overall FF scenario and testing requirements for a future planned study. Also covers aspects of Darwin FF requirements.

The XSAG are preparing the science requirements document needed as input to this process.

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XEUS – Study Activities

These studies will provide inputs to two more extensive industrial studies:

- XEUS System Study covering the design of both spacecraft, FF aspects, and the overall mission scenario. The projected start date in October 2005 and the duration 12 months.
- In April 2006, a second FF study is planned. This will implement the ground test bed arising from the earlier FF study.
- Following the System Study, there will be a 3 month consolidation phase until the end of 2006.

XEUS – Study Activities

In addition, the following payload related studies are planned for 2005:

- HPO (high-precision pore optics) optics development is about to be started. Covers HPO development for 15 months, including stacking technology and mounting, leading to a petal model containing some stacked modules.
- Optical baffle design. Stray light is the major issue to be addressed. Expected start date is May-June 2005.
- Continued development of detector, multi-layer, and cooler technologies.

XEUS – Next Steps

- Assuming successful outcomes to the studies, and that XEUS continues to be highly ranked in the CV1525 process, then the mission would be ready to be handed over to ESA's Science Projects Department (the engineers) to start its (parallel, competitive studies) definition phase (A/B1) at the end of 2006.
- For a global mission, we would have to have an inter-agency agreement defining responsibilities by the end of 2006 – otherwise we will not know what European industry should study!
- Following these steps, a possible (technical) schedule would be:

XEUS – Overall Schedule

Mission

- Definition phase (A/B1, competitive): 2007-2008
- Design phase (B2, prime selected): 2008 -2009
- Phase C/D: 2010 – mid 2015
- Launch campaign: 2016
- Launch: 2016
- Operation (nominal): 2017 to 2022

Optics

- HPO module optical model: mid 2005-end 2006
- Petal engineering model: 2007-2008
- Infrastructure development: 2008- 2010
- FM production: 2010 to 2014
- Mirror MSC AIT: 2015

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XEUS – Summary

XEUS is doing very well in CV1525, but there are (at least) a couple of potential pitfalls:

- We get "Bushed" - Europe gets seriously into Exploration
- Major cost overruns in current ESA Science Programme could delay XEUS.

From a European perspective, there are also major opportunities ahead. Collaboration with the US would:

- Demonstrate that the mission has global support – it's the mission that we *all* want.
- Reduces the costs to Europe (both ESA and the Member States) and Japan, so increasing the attractiveness of the mission to the decision makers.
- Reduces the risk of delays – see how LISA has benefited from this.
- By combining European and Japanese strengths and resources with those from the US, provides for a better mission.

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